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SEABEE OPERATIONS now include computer support in overseas sites. The three part story begins on page 20.

HAZARDOUS WASTES could prove to be a lurking monster if current disposal standards are not followed. See page 3.

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NOTE: An article concerning the Advanced Base Sectional Dock of WWII fame by Ted C. Murphy and originally scheduled for this issue is delayed to a later edition.

HAZARDOUS WASTES

Disposal problems of the '80s

BY LCDR JOHN G. LEECH, CEC, USN
Director, Environmental Quality Division
NAVFAC HQ, Alexandria, VA
P.E., PA

• Alexandria, Va.

After a long neglectful history the nation is finally coming to grips with a sleeping monster of the 80's—the improper management of hazardous materials. The danger presented by hazardous materials has been well-documented with new incidents being reported daily. The incidents include: transportation accidents, overflowing and leaching chemical dumps, ruptures of storage tanks, chemical pollution of rivers, and so on.

To tackle this insidious problem, the U.S. Environmental Protection Agency and several states are issuing a blizzard of regulations aimed for proper hazardous waste management and clamping down on spills. We will try to cut through the regulatory confusion and show how the Navy will be affected. Also discussed is the newly-developed Navy program to aid shore activities and ships in complying with these regulations.

How serious is the hazardous materials problem at Navy activities? Five case histories, illustrating a variety of problems, may emphasize the potential seriousness.

Slurry Pit?

Activity 'A' is a Naval Air Station with a Naval Air Rework Facility (NARF) as a tenant. The NARF produces a wide range of hazardous wastes i.e., plating wastes, strippers and thinners, waste paints, and various solvents. The plating wastes can be treated at the activity's industrial waste pretreatment facility and then released to the sanitary sewer.

But what about the other wastes? Or the sludge produced during the treatment of the plating wastes? The state in which Activity 'A' is located has no approved disposal or recycling sites to receive the hazardous wastes. In fact, the nearest out-of-state site is more than 500 miles away.

It is unlikely that the state will soon open a hazardous waste disposal site since the area's water table is just beneath the surface. Without a very costly engineering effort, such a site could pollute the groundwater which is a source of drinking water.

Seemingly, there is no place for the wastes. But the law of conservation of mass (with a little paraphrasing) states that "those hazardous wastes which are generated, must eventually be disposed." So Activity 'A' maintains an unofficial disposal site known as the "slurry pit." The slurry pit is a man-made unfilled lake of chemicals located in the "back-forty" of the activity.

To make matters worse, nearby housing takes its drinking water from wells sunk adjacent to the slurry pit. The activity's environmental coordinator is now worried that hazardous waste from the slurry pit may be leaking into the groundwater and polluting the residents' drinking water.

What's the solution to his dilemma?

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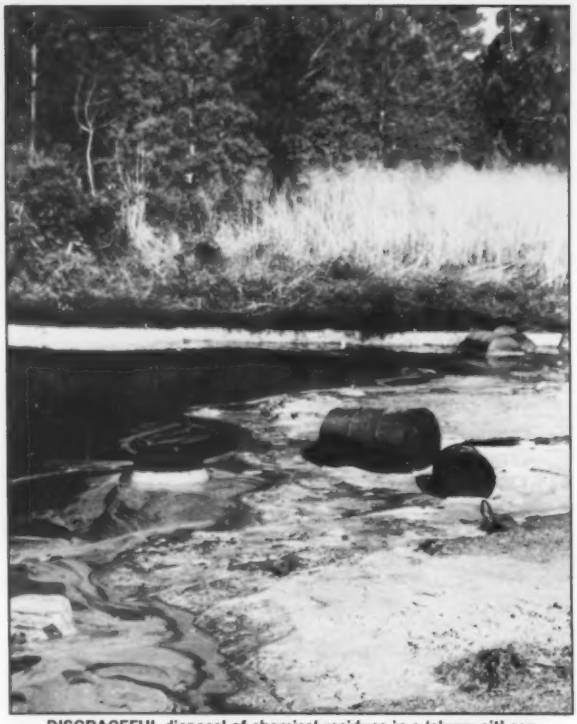

DISGRACEFUL disposal of chemical residues in a 'slurry pit' can lead to contamination of underground water supplies.

Activity 'B' is a large Navy installation with an on-base power generation facility. During the past few years, leaking electrical transformers, containing toxic polychlorinated biphenyls (PCBs), were removed from service and placed in a nearby storage area. When the storage area became full, the transformers were sold to a local salvage company.

Oh, No, A PBC Spill!

The company, a small operation, worked out an agreement whereby the purchased transformers could be transported to the salvage yard in trucks loaned by the activity. While unloading the transformers, a salvage yard forklift operator tilted a transformer, spilling the PCB liquid on the truck floor boards, a concrete driveway, and a nearby asphalt apron. The outraged salvage yard manager quickly called the activity Public Works Officer emphatically saying that the men had not been informed of the potential health and environmental hazards of PCBs. In fact, he wasn't even aware that the transformers were filled with PCB liquid. The irate salvage yard manager demanded that the activity pay for cleaning up the spill, restore his place of business, and reclaim the leaking transformers.

Since the spill involved government vehicles, Activity 'B' agreed to assess the damage and assist with the cleanup operation. After examining the spill site, an activity representative decided that the spill was too big an undertaking for his ill-equipped crew and obtained a contract for the cleanup. The resulting operation was very costly and included removal of the truck floor boards; removal, disposal, and replacement of the asphalt apron; and decontamination of the concrete driveway, truck exterior, and other equipment used in the cleanup operation. All leaking transformers had to be drained of PCBs and flushed with a solvent. The PCB liquid was returned to the original storage area to await incineration. All other PCB-contaminated materials, including the emptied transformers, were transported 100 miles to an approved disposal site.

After this costly episode, the activity became more aware of the problems involving PCBs and looked closely at recent Federal regulations on the toxic material. The regulations place strict control of PCBs to prevent them from entering the environment; once they enter the environment, PCBs will remain there for years due to their "persistent" nature. The regulations cover all aspects of handling, labelling, transportation, and disposal of PCBs.

Because of the environmental and health consequences from PCB spills, a spill contingency plan was developed for the PCB storage facility, and personnel were provided training in spill prevention and response procedures. They were also instructed to report PCB transformer spills to the activity's on-scene coordinator for relay to the Naval District.

Sometimes an activity's haste in disposing of a hazardous waste can come back to haunt—first make sure it's a waste with no use! A case in point: Activity 'C' stored large quantities of decontamination chemicals in a ramshackle warehouse. These chemicals (with names

such as supertropical bleach (STB), DS-2, DANC-M4, antiset, ethylene oxide, formaldehyde) were stored in the mid-50s as part of the activity's disaster preparedness program. In case of enemy NBC (nuclear, biological, or chemical) warfare, the chemicals would be used to decontaminate the activity.

Several years ago, Activity 'C' was notified that an IG inspection would soon take place. A preliminary inspection by the activity commanding officer discovered the 25-year-old decontamination chemicals; many in severely rusted containers. The sight of the deteriorating chemicals appalled the CO. His concern was heightened when he learned that mixing of DS-2 and STB can cause a fire. He ordered the immediate removal and disposal of all decontamination chemicals stored in the warehouse. Activity 'C' passed the IG inspection with flying colors!

Four weeks later, the activity received a letter from the Naval District Disaster Preparedness Officer. The correspondence requested a status report on the activity's disaster preparedness program together with a list of materials on hand. A check with the Naval District revealed that there was a continuing requirement to maintain decontamination chemcials. Many of the chemicals, which already were disposed, could have been retained. Now, the activity would have to use its hard-pressed funds to replace the chemicals.

What Do We Do With Our Asbestos?

Activity 'D' is a naval shipyard which is concerned about the large quantities of asbestos generated during rip-out operations. The activity has become quite consicous of worker health problems as related to breathing asbestos fibers. A comprehensive asbestos program has been established in which extreme care is used in rip-out operations to protect the worker. Included are: requirements for respirators, protective clothing, and dust control. A full-scale surveillance program has also been set up to investigate medical problems in former employees due to asbestos exposure.

Asbestos wastes, generated during rip-out operations, are wetted and placed in heavy-duty plastic bags. The bags are sealed, labelled with a warning, and stored awaiting disposal.

And, this is where Activity 'D' has been having a problem. Asbestos is clearly a hazardous waste and, therefore, the activity figured it must go to a hazardous waste disposal site. Since no hazardous waste disposal sites are located nearby, the shipyard has been accumulating bags of asbestos in a central location.

What should Activity 'D' do?

Their solution was simple. Along with a representative of their NAVFAC engineering field division, the activity discussed their asbestos situation with state officials. No problem, said the state, just take the bagged asbestos to an approved sanitary landfill—it doesn't have to go to a hazardous waste disposal site. The state officials explained that the only hazard presented by asbestos was in breathing the fibers. After it is wetted, bagged, and labelled, it no longer is considered a health problem and can go to an ordinary landfill—as long as it is buried immediately without damaging the bags.

Most states have the same requirements as those in which Activity 'D' is located. However, some states have imposed tougher requirements (see map), so the safe bet is to talk with state officials before disposing of asbestos.

Activity 'E' is a major supply complex which recently received a costly lesson on the consequences of improper storage of hazardous materials. The materials in question were several pallets of bleaching powder stored next to boxes of detergent in a general warehouse. The powder had been transferred from a ship to the warehouse after several cardboard boxes containing the bleach were found to be punctured. No attempt was made to repackage the bleach.

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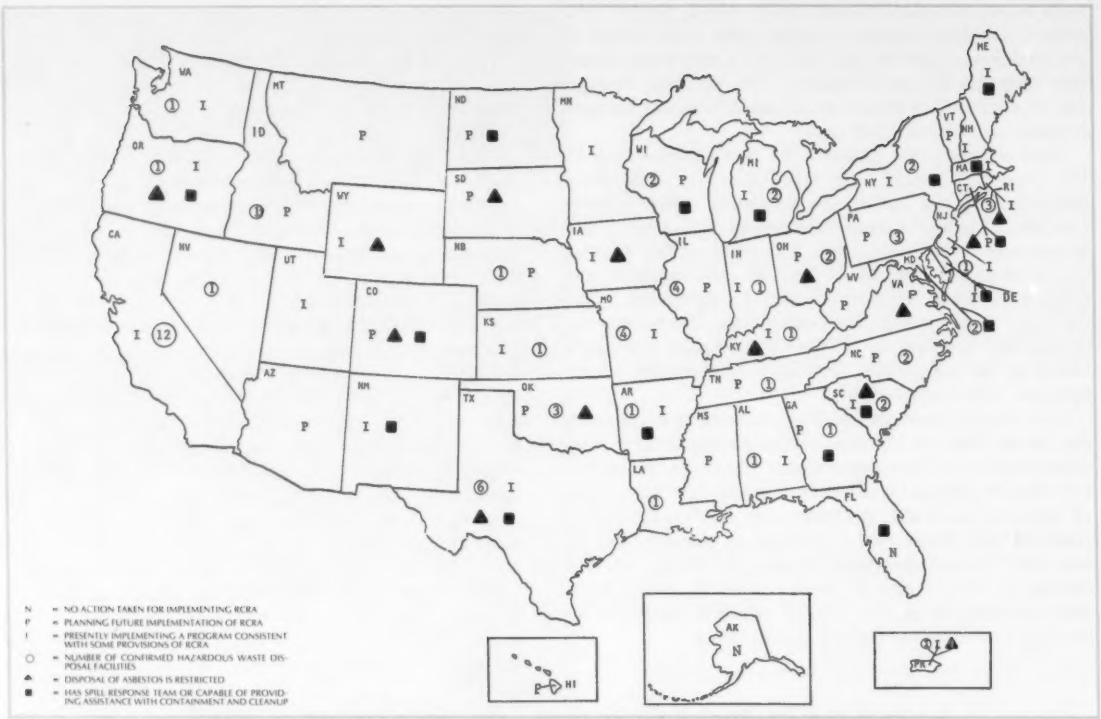
PROPER disposal of suspected dangerous waste is made in state approved disposal sites.


N = NO ACTION TAKEN FOR IMPLEMENTING RCRA
P = PLANNING FUTURE IMPLEMENTATION OF RCRA
I = PRESENTLY IMPLEMENTING A PROGRAM CONSISTENT WITH SOME PROVISIONS OF RCRA
○ = NUMBER OF CONFIRMED HAZARDOUS WASTE DISPOSAL FACILITIES
▲ = DISPOSAL OF ASBESTOS IS RESTRICTED
■ = HAS SPILL RESPONSE TEAM OR CAPABLE OF PROVIDING ASSISTANCE WITH CONTAINMENT AND CLEANUP

PROGRESS, or lack of, in disposal control of hazardous material is indicated by individual states.

(continued from preceding page)

The story now shifts to a summer day, one month after the powder entered storage. In the early morning hours, a blaze erupted at the warehouse. Firemen quickly responded to the blaze, but several were overcome by fumes. Finally, the firefighters realized that the only way to extinguish the fire was to flush the bleaching powder into the bay. The resulting chemical spill is an embarrassment to the activity which was also fined by a local regulatory agency.

What went wrong? From a chemist's viewpoint, the explanation is simple. Bleaching powder had spilled out of its container and had come into contact with the nearby detergent. The mixture reacted in the humid summer air with a resulting increase in temperature; eventually, the materials ignited. As the fire grew, the warehouse's sprinkler system was activated. The heavy dose of water compounded the problems by reacting with the bleaching powder to liberate toxic chlorine gas which had overcome the firefighters.

That's not all. The water from the sprinklers may have reacted with some sodium cyanide which was also in storage. This could have released enough hydrogen cyanide gas to kill!

With all these chemical reactions occurring, the firefighters' dilemma in attempting to control the blaze is apparent. First, they had little knowledge of what was stored in the warehouse. Second, they couldn't get close enough to the fire to fight it because of the gases. Third, the more water they used to control the blaze, the more gases they liberated. The final solution to this mess: flush the bleach into the bay.

Activity 'E' was embarrassed by this incident, but luckily, no one was critically injured. Afterwards, activity personnel pondered the lessons they had learned. First of all, the fire department should have had a spill contingency plan describing which materials were in storage, how to handle an emergency, and what protective equipment would be required. Secondly, storage of hazardous materials is a serious business, involving the selection of a suitable storage area, the use of leakproof containers, and the segregation of incompatible materials.

Regulations, Regulations, and More Regulations

A bewildering maze of hazardous materials regulations, (both Federal and state), is either proposed or in effect. The objective of these regulations is to strictly control hazardous materials to protect our environment and the health of our citizens.

Federal laws, currently in effect, include:

- *Resource Conservation and Recovery Act (RCRA).* The law provides for the effective management of the country's hazardous wastes. Regulations are being developed to control wastes from generation to disposal. The controls will consist of: a shipping manifest system to document the transport of wastes from the the generator to the disposal site, and a permit system to regulate hazardous waste storage, treatment, and disposal facilities. In most cases, hazardous waste programs will be run by the state and not the federal government. Most

states have either developed or are developing hazardous waste regulations in conformance with RCRA (see map).

- *Clean Water Act (CWA).* The Act will regulate the spills of hazardous substances. Fines will be assessed for spills of certain substances in excess of specified "reportable quantities." Further regulations will mandate the development of plans to prevent spills and the establishment of emergency procedures in case of spills.
- *Other Federal Laws and Regulations.* Several other federal laws and regulations concerning hazardous materials are right now on the books. One strong law is the *Toxic Substances Control Act* which strictly regulates substances presenting extreme hazards (e.g., PCBs). Transportation, packaging, and labelling of hazardous materials is controlled by Department of Transportation regulations. Other regulations have been issued to protect the employee within the workplace from harmful exposure to hazardous materials, as required by the Occupational Safety and Health Act (OSHA).

Materials Management Program

The Navy will soon be initiating a program to aid shore activities and ships to comply with state and Federal hazardous materials regulations. This program, which will be implemented by an OPNAV notice, entails the development of three plans:

- Hazardous Waste Management
- Hazardous Materials Spill Prevention Control and Countermeasures (SPCC)
- Hazardous Materials Spill Contingency

The Hazardous Waste Management Plan will present the activity's approach to managing its hazardous wastes from the point of generation (e.g., paint wastes from an aircraft hangar) to ultimate disposal (e.g., contract chemical landfill). Between generation and disposal are many intermediate steps such as storage, transportation, and transfer. All these steps must be addressed in the plan to ensure that hazardous wastes are not introduced into the environment. Effective management of hazardous wastes would eliminate such undesirable practices as the slurry pit earlier referred to at Activity 'A'.

What would a good hazardous waste management system look like? A typical system would work this way: hazardous wastes from shops and ships are taken to a central storage facility at the activity where the facility operator arranges for the appropriate recycling, treatment, or disposal of the waste. In most cases, he will simply call a contract hauler (who has state approval to transport hazardous wastes) to pick up the waste.

The facility operator will take care of all paperwork requirements such as the state-required shipping manifests for hazardous waste. The operator will also provide technical assistance to all shops on an as-needed basis. This kind of management system will not come cheap, particularly since some hazardous waste may have to be hauled 500 miles or more to acceptable disposal sites. The Navy will simply have to pay the price. Approved hazardous waste disposal sites located in this country are depicted on the map illustration.

A good management system will eliminate the need for a 'slurry pit.' But having operated a chemical dump, you can't simply cover it up and forget it! Chemicals may continue seeping into groundwater for years, causing untold problems. Such past sites may even have to be evacuated, and the materials moved to an approved hazardous waste disposal site. (The Navy is currently developing a separate program to investigate past hazardous waste disposal operations and figure out how to deal with them.)

The SPCC and Spill Contingency Plans will address the issue of hazardous materials spills at the activity. The SPCC Plan is an engineering document aimed at preventing spills from entering the environment. For instance, the plan might recommend that a containment berm be built around a storage yard, containing several 55-gallon drums of chemicals, so that a leak would be confined within the yard.

The Spill Contingency Plan provides emergency procedures in case of a hazardous materials spill. In most instances, responsibility for dealing with spills will lie with the activity's fire department. Their job won't be easy when the great variety of materials used at Navy activities is considered (e.g., toxic chemicals, explosives, corrosive acids). Large spills may exceed the Navy's in-house resources, requiring assistance from EPA, the Coast Guard, or private firms. States providing spill assistance are also depicted on the map.

Hazardous materials management involves many interests at the activity, including supply and safety officers, industrial hygienists, disaster preparedness officers, and the environmental coordinator. It might be in the best interest of an activity, particularly a heavily industrialized one, to set up a committee to look into all aspects of hazardous materials management, from procurement of the materials to their eventual disposal. This committee could develop specific recommendations related to replacement of materials, recycling, safety precautions, and so on.

Technical Assistance

Suppose your activity has a problem in disposing of a hazardous waste or you have a spill of PCBs. Where can you turn for help for these and other hazardous materials problems?

The first turn will probably be to your NAVFAC EFD. Each EFD has a hazardous materials specialist in the environmental branch (generally, code 114). Another source of information is the Navy Environmental Support Office (NESO) at Port Hueneme, Calif. Both NESO and the EFD primarily deal with hazardous waste management and spills of hazardous materials. Both have access to the oil and hazardous materials technical assistance data system (OHM/TADS), a computerized system specifically oriented towards providing spill response information. Personnel contacts are listed at the conclusion of the article.

Other organizations can help with hazardous materials problems related to personnel safety and the workplace environment. The Navy Environmental Health Center (NEHC) in Norfolk, Va., can provide guidance concerning the health-related aspects of many different hazardous materials, including Federal standards and recommended protective equipment (see

(continued next page)

DAILY discards from routine maintenance are often disposed as ordinary refuse—rather than suspected material.

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table). This kind of information can also be provided by the activity's industrial hygienist. (A safety perspective on hazardous materials problems can be gained by reading *Lifeline*, a journal published by the Naval Safety Center in Norfolk. This publication frequently discusses hazardous materials handling at Navy activities.) Specific safety guidance can be provided by the activity's Safety Officer.

Defense Property Disposal Offices (DPDOs), located at all major Navy activities, should be contacted concerning hazardous wastes with a commercial value. Such "wastes" as elemental mercury, waste oils, and some waste solvents are obviously marketing possibilities.

Every activity should maintain the following Navy references for on-the-spot information on hazardous materials:

- *Navy Hazardous Materials Management Guide, NESO 20.2-024A.* This publication offers guidance in managing hazardous materials to protect the environment and comply with all applicable requirements. The guide specifically aids the Navy activity in developing the three required plans discussed earlier.
- *Hazardous Waste Disposal Guide, NESO 20.2-011.* This six-part document provides Navy activities with procedures for characterizing, handling, processing, and disposing of hazardous wastes. The guide specifically addresses those wastes generated by Navy operations. The publication also provides information on hazardous waste disposal companies and lists Navy, Federal, and state contacts for technical assistance. The guide appears in a looseleaf format to facilitate insertions of updates.
- *Consolidated Hazardous Item List (CHIL), NAVSUP Publication 4500.* This document provides disposal guidance for degraded stock items supplied through the NAVSUP system. These items may require disposal because they have become obsolete, excess, or have exceeded their shelf life. CHIL identifies the hazardous items by their name and national stock number. It currently addresses 4000 stock items with more being added annually.
- *NESO Pollution Solutions (PSs) and Information Bulletins (IBs).* These documents, which are issued by NESO on an as-needed basis, frequently address hazardous materials issues of current concern in the Navy.

To further enhance their hazardous materials technical libraries, activities may want to purchase one or more of the many excellent references issued by various publishers. A listing of recommended desktop references has been prepared by NESO.

The Navy, as well as other defense agencies, are only beginning to see the snout of the 'sleeping monster' where hazardous materials are concerned.

As new regulations are published under various laws, more restrictions will be placed on the use and disposal of hazardous materials. This will place a heavy but necessary burden on field activities and the fleet. □

Contacts for Hazardous Materials Assistance

Organization	Contact	Location	Code	AUTOVON
NAVFAC (Headquarters)	Ted Zagrobelny	Alexandria, VA	1122A	221-8176
Chesapeake Division	Lida Whitaker	Washington, D.C.	104	288-3761
Northern Division	George Wiese	Philadelphia, PA	114/GW	443-4972/4702
Atlantic Division	Sonny White	Norfolk, VA	1141	690-7313
Southern Division	Joe McCauley	Charleston, SC	114B	794-5510
Western Division	Carl Payne	San Bruno, CA	1142	859-7493
	Joe Kaminski	San Diego, CA	1141D	933-8853
	Gale White	Seattle, WA	1143A	941-3916
Pacific Division	Ernie Capaldo	Honolulu, HI	11412	471-3948
Navy Environmental	Bill Powers	Port Hueneme, CA	2512	360-4267
Support Office (NESO)	Rick Gardner	Port Hueneme, CA	2512	360-5749
Navy Environmental	Art Johnson	Norfolk, VA	42	690-3672
Health Center (NEHC)	Jim Crawl	Norfolk, VA	42	690-3672

Advice of Counsel

About inverse condemnation

WILLIAM H. SPECK
Counsel, NAVFAC HQ

• Alexandria, Va.

"Where laws end, tyranny begins"—William Pitt

"Inverse condemnation"—a contradiction in terms, or an apt description?

Condemnation is a legal action in which a sovereign government sues a property owner to take ownership of some of his property, to determine fair compensation and pay the proper owners, and to take possession of that property for public improvements.

Usually the Federal Government and many states condemn by "quick taking"—filing with the court a Declaration of Taking and a check for the fair value of the property, which transfers title at once, leaving the court to order delivery of possession and the owner to accept or contest the deposited compensation.

The legal suit is necessary to satisfy the United States Constitution Fifth Amendment requirement: "—nor shall private property be taken for public use, without just compensation."

The same obligation is imposed on states by the Fourteenth Amendment prohibition against depriving anyone of life, liberty or property without due process of law and by state constitutional prohibitions against taking or damaging property without fair compensation. The legal suit is due process of law, takes the property, and fixes fair compensation.

But suppose the government (Federal or state) has not brought such a suit because it does not consider it is taking any property and indeed vigorously denies taking; but the property owner insists Government actions have taken his property—either by physical acts or by depriving him of its use or value.

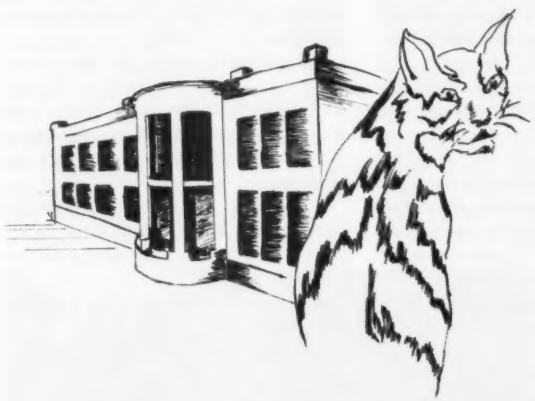
A government waterway project may have waterlogged or periodically flooded his land. Government restrictions on use or development, or denial of financial and public improvement assistance usually available may have barred all practical uses. Firing big guns or flying planes over his land may have frightened or discommoded living occupants. In such circumstances the owner may bring an "inverse" (perhaps more meaningfully, *"reverse"*) condemnation suit demanding fair compensation for the taking of his property.

Suits under the last mentioned circumstances—overflights by aircraft—provide the most common basis for inverse condemnation suits. These trace back to *United States v. Causby* (1946). Flights over the plaintiff's chicken farm, on take-off and landing with glaring lights and startling noise, caused 610 chickens daily to dash and destroy themselves against walls; and the family to lose sleep and to be generally frightened.

The court supported aviation by holding the airspace to be "a part of the public domain" but also held flights over private land "so low and so frequent as to be a direct and immediate interference with the enjoyment and use of the land" to be a "taking" entitling the owner to fair compensation.

This case became the paradigm of hundreds of others as another way in which citizen suits, the courts, and the law control and compensate for Government actions. □

Sea(bee) Stories



A Pacific task force headquarters was located near that of a Seabee battalion in Vietnam during the late 1960s.

One day the task force commodore asked the battalion commanding officer if the Seabees would build a cat house for him. Naturally, the request was received with some amazement.

But it was quickly learned that the commodore wanted a place to actually keep a kitten. So the Seabees got together and built him a cat house, which resembled The White House, complete with white columns and portico.

The Seabees presented the commodore with their creation plus a kitten-in-residence. After several months the commodore realized that he had an *unusual* cat.

It developed that the Seabees had given him a tiger cub which, at last report, is now enjoying life in an American zoo.

Seabees reduce Jamaican storm damages

By LT CHARLES A. HEINRICHS, CEC, USN
P.E., Calif.

• Little Creek, Va.

Auchidown, Orminston, Sweet River, Bluefields, Barham Bridge—sound as they may, these are not United Kingdom sites, but locations in Jamaica that were devastated by severe flooding last summer. A freak rain storm, that began June 12, dumped a total of 50 inches of rain on Jamaica within two days! Numerous road and bridge washouts resulted in the island's transportation network being critically disrupted. Additionally, thousands were left homeless from the tropical deluge.

In Chief U.S. Atlantic Fleet (CINCLANTFLT) tasked the Commander Naval Construction Battalions, U.S. Atlantic Fleet (COMCBLANT) to dispatch an engineering assessment team to Jamaica and to assist the Jamaican Ministry of Works personnel to determine the extent of damage and to make repair recommendations to the U.S. ambassador.

Members of the engineering assessment team included CDR Bruce MacCall, CEC, USN (COMCBLANT operations officer), Lt.Col Roy Marks, USMC, Fleet Marine Force, Atlantic (FMFLANT force engineer), EOCS A. D. Christie (COMCBLANT Det Gulfport), SWCS A. B. Amick (NMCB-40 operations chief), S. R. Bennet and W. R. Gibbings (Atlantic Division, Naval Facilities Engineering Command).

The initial assessment, completed in about five days, indicated that the preponderance of damage included washouts of box culverts, failures of single span bridges, and transverse and longitudinal washouts of primary and secondary roads. Transverse washouts varied from 10 to 60 feet wide and 3 to 60 feet deep. Longitudinal washouts were 6 to 10 feet deep and up to a mile long. On June 29, the complete situation assessment for Jamaican disaster relief requirements, was provided to CINCLANTFLT, the U.S. Secretary of State, and Secretary of Defense for planning purposes. While an official request from the Jamaican government for assistance was pending, local and U.S. representatives were hard at work negotiating an agreement defining the scope of work and individual funding responsibilities. In the interim, COMCBLANT, in conjunction with other U.S. Navy commands, were busy readying equipment, personnel and transportation requirements in anticipation of official orders.

The proposed disaster relief plan identified a requirement for 90 Seabees from the Naval Construction Force (NCF) to complete temporary or permanent bridge and road repairs within 60 days after arrival. The use of a 65-man bridge detail from the Marine Combat Engineers was recommended to erect M-6 bridges as bypasses until the Seabees could complete more permanent repairs. On August 9, two months after the floods devastated Jamaica, an official request for assistance was received by the U.S. Secretary of State, with an international agreement that the Jamaican government would provide $1.4 million to fund the operation expenses. In addition, the Jamaican government agreed to procure and provide necessary local construction materials.

The ball was now rolling! On August 14, CINCLANTFLT then ordered COMCBLANT to coordinate repair efforts utilizing joint Navy and Marine Corps construction forces. At this time the engineering assessment team revisited Jamaica to perform these chores:

- Update the previous survey reports taking into account work that had already been completed and making recommendations regarding those other sites needing urgent attention.
- Develop with the Jamaican Ministry of Works staff final technical plans for accomplishing negotiated projects.
- Inspect materials to be used in the rehabilitation work and to act as an advance party for the construction group.

CDR J. R. Jacobsen, CEC, USN, Commanding Officer, Naval Mobile Construction Forty (NMCB-40), was designated the operation force commander of the joint Navy/Marine detail. The Marine Corps 8th Engineer Support Battalion, based at

Camp Lejeune, NC, deployed a bridge company with tactical M-6 bridges. The Marines also provided dental, messing, water purification, and communication services for the combined detail. The Atlantic Division of NAVFACENGCOM was responsible for project design and on-site engineering assistance.

The *USS Portland*, which was assigned to transport the Seabees and Marines to Jamaica, departed the Naval Amphibious Base, Little Creek, Va, August 16, and proceeded to Morehead City, NC. There, the *Portland* embarked 70 Marines, 20 pieces of construction equipment, 23 M-6 bridge trailers, and 3,000 square feet of plastic matting (MOMAT). The *Portland* next sailed to Gulfport, Miss., to pick up several pieces of construction equipment and an additional 10,000 square feet of matting. Leaving Gulfport, the *Portland* began its long journey to Roosevelt Roads, Puerto Rico, arriving August 25, where 80 Seabees from NMCB-40 boarded the ship with tent camps and 72 pieces of construction equipment. The trip from Roosevelt Roads, to Montego Bay, Jamaica, proved to be the climactic leg of the journey for the *Portland*.

Hurricane *David*, which by now had commenced its onslaught in the Caribbean, required the *USS Portland* to seek refuge at Guantanamo Bay, Cuba. The *Portland* departed Guantanamo Bay on August 30 and Hurricane *David*'s unpredictability surfaced once again! Because the hurricane was projected to hit Jamaica, the *Portland* undertook hurricane evasion maneuvers 350 nautical miles south of *David*. After a 6-day delay, the *Portland* arrived at Montego Bay on September 2 and began the unloading of equipment. The Seabees and Marines, completed a 24-hour job in half the time. The combined detail began its convoy to the southwestern part of the island and set up its camp near Savanna La Mar in an area called "paradise park." Getting situated was extremely difficult, heavy rain and ankle-deep mud hampered convoys and camp work crews throughout the week. Perseverance enabled the camp to be completed on September 7, two days ahead of schedule! Numerous and difficult projects challenged the Seabees and Marines during the next three months. Most of the work involved rebuilding of several miles of roads and drainage canals. Slopes and embankments were stabilized through the use of gabions (rock-filled rectangular wire mesh baskets) tightly stacked in various configurations.

"We used two sizes (of gabions)", explained LT Glenn Rodriguez, CEC, USN, officer in charge of the detail. "One called a mattress that measures three feet by six feet and one foot high, the other is also three feet by six feet, but *three* feet high." The principle is that running water can move a rock, but it takes a lot more force to move the whole basket.

Between the towns of Savanna La Mar and Bluefields, Seabees installed in a riverbed an elliptical culvert measuring 22′ by 36′ by 80′ long and realigned a road over it. Seabee talent was displayed in the raising of Barham Bridge. The 120-ton single span steel bridge collapsed into the river when floods washed out one of its abutments. The Marine bridge engineers played a major role by spanning the 80′ wide river directly above the fallen bridge with one of its tactical M-6 bridges. The Seabees and Marines rigged block and tackle between the two bridges, and by using the M-6 bridge as a gantry and pulling with two bulldozers, raised the existing one.

A cofferdam was built around the damaged south abutment and the trapped water pumped out. The new concrete abutment and wing walls were formed and poured. While working around the south abutment, the repair crew discovered that the north abutment was undergoing substantial differential settlement. The cofferdam on the south side was restricting the flow of water, thereby increasing its velocity. As a result, cavitation was occurring under the footing of the north abutment.

A group of Seabee divers from Underwater Construction Team One (UCT-1) led by LCDR Geoff Cullison, CEC, USN, were sent to Jamaica to investigate the situation and create a fix. The divers found that the footing had been undermined for a depth of approximately 18 inches. Thomas L. Coates, a technical representative from Aquatic Marine Systems, Tampa, Fla, assisted with the on-site evaluation. He recommended use of ballistic reinforced nylon bags which were placed empty underneath the footing and filled with concrete to fill the void space. Concrete was pumped through a trimmie pipe attached to the base of each form, and as the form was filled with concrete, the trimmie pipe was withdrawn. Sandbags were also packed around the forms to fill smaller voids. After work on both abutments was completed, the existing bridge was lowered back into position. The M-6 Bailey bridge proved vital to the success of the reconstruction operations. These bridges enabled Seabee equipment operators to get into otherwise inaccessible areas for repair of damaged roads and bridges. After the Seabees completed the necessary

(continued next page)

Restoration of Jamaican roadways.

Barham bridge came falling down

A Marine M-6 bridge supports the repositioned Barham bridge.

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repairs, the M-6 bridges were retracted.

The Seabees would be the first to admit that the success of this reconstruction effort was highly dependent upon the assistance rendered by the local populace, and in particular by the Jamaican Defense Force. The Seabees established an excellent working relationship with the Jamaicans at the deployment sites and with government officials. Jamaica's prime minister and the U.S. ambassador to Jamaica visited the camp and construction sites and expressed their appreciation for the work being done by the Seabees and U.S. Marines.

The work performed by the Seabee/Marine detail was completed. The Marine Engineers have returned to Camp Lejeune, NC, and the Seabees to their original deployment site at Camp Moscrip, Roosevelt Roads, Puerto Rico. NMCB-40 has returned to Port Hueneme, Calif.

A review of the accomplishments in Jamaica include:

- *Orminston*—Raised existing road five feet to prevent future flooding; widened the road and installed 130 lineal feet of three-foot diameter flood relief culverts. Required 6,000 cubic yards of fill.
- *Auchindown*—Reconstructed 2½ miles of road surface where washouts averaged four to ten feet in depth. Required use of 18,000 cubic yards of fill and base course, 1000 gabions, and 120 lineal feet of four-foot diameter culverts.
- Caves gully and caves switchbacks—Restored access to mountainous areas by installing culverts and re-building switchback roads.

Caves Gully: 2500 lineal feet of road restored; placed 130 gabions; and installed 260 lineal feet of four-foot diameter culverts.

Caves Switchbacks: placed 30 gabions; and installed 40 lineal feet of four-foot-diameter culverts.

- *Main Island Circumferential Route A-2*—Returned road bed to original width and stabilized shoulders with gabions. Nine separate washouts were backfilled; the largest was 160 feet long and the deepest measured 60 feet. Also required were 490 gabions and 3,000 cubic yards of fill.
- *Sweetriver Area*—Restored secondary roads used for agricultural transfer. Installed 160 gabions; 120 lineal feet of four-foot diameter culvert.
- *Waterworks*—Channeled and widened 1300 feet of stream bed. Placed a double row of 500 gabions upstream. One hundred feet downstream installed three level step energy dissipators using 250 gabions.
- *Bluefields*—Completed installation of culvert—required 370 gabions; 100 cubic yards of concrete for invert curtain walls, wing walls and thrust beams; and 14,000 cubic yards of fill.
- *Barham Bridge*—Raised existing steel span; built new south abutment; repaired north abutment; lowered existing bridge into position.

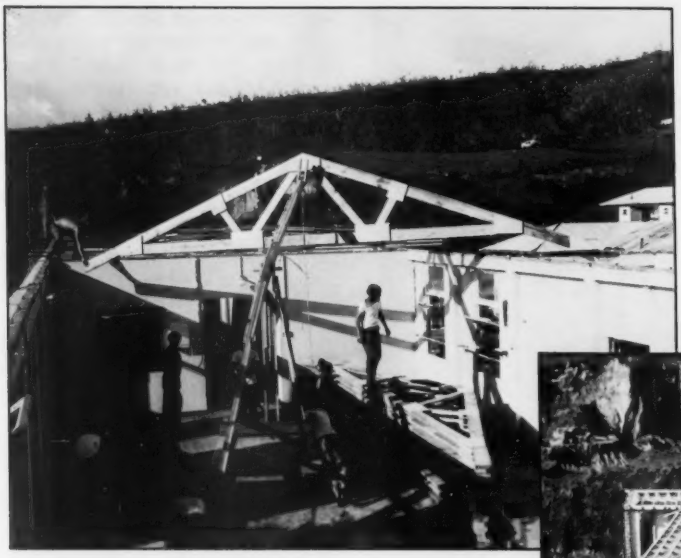
All in all, approximately 4,000 2-3 ton gabions were used during the reconstruction effort; and that's a lot of rocks!

Despite the usually encountered construction delays (inclement weather, material unavailability, equipment breakdowns), the detail completed all projects. Quite an achievement considering that a group of NMCB-40's contemporaries was simultaneously involved in another relief effort on the Caribbean island of Dominica. The success of the Jamaican effort, as well as that at Dominica, could not have been possible without the commitment of a total team effort. So, add another chapter to the book of Seabee "Can Do" legacies. □

The tactical M-6 is an aluminum single-lane pony truss bridge having a curb-to-curb width of 13.3 feet. It can be erected by hand or crane to bridge gaps from 15 to 255 feet. A 60-foot span weighing 24 tons can be assembled by hand and moved in place in 4 to 6 hours by a 25-man crew. The bridge can safely carry up to 130 tons. □

In the mountainous region called Newmarket, valley floors were completely inundated by the severe flood waters. New lakes were created, the largest having an area of four square miles. The depth of water averaged 30 to 40 feet but some as great as 90 feet. Previously, drainage in this area was effected by limestone sink holes. Hydrologists surmise that these limestone sink holes had filled with debris causing water to back up. Another theory is that an underground river may be draining into this area. □

another storm ... more repairs in Dominica



By LT JAMES E. FOSTER, CEC, USN
P.E., Pa.
and
LT CHARLES A. HEINRICHS, CEC, USN
P.E., Calif.

• Little Creek, Va.

It was absolutely awesome!

The Commonwealth of Dominica, the most northerly of the Windward Islands, was devastated by Hurricane *David* on August 31, 1979. The hurricane, which caused widespread destruction in other areas of the Caribbean and along the eastern seaboard of the United States, took 40 lives and left 60,000 of Dominica's 80,000 inhabitants homeless.

Damage was so severe that the electrical generation and distribution system was destroyed and the island's water distribution system was inoperable. Houses lost their roofs while others were upended and tossed around by *David's* 150-knot winds. The only hospital on the island, located in the port city of Roseau, which is Dominica's capital, lost the roofs of its ten-building complex. Warehouses at the Roseau Port Authority, where seasonal agricultural products are stored, lost their roofs and suffered extensive structural damage.

The two major island roads, from the Melville Hall Airport to the port city of Portsmouth on the northern end of the island, and from the airport to Roseau on the southeastern tip of the island were blocked at numerous points by fallen trees, utility lines and massive earth slides.

The American Embassy, Bridgetown, Barbados, requested the U.S. Secretary of State to form and deploy a Disaster Assistance Survey Team (DAST) to Dominica to conduct systematic air and ground reconnaissance of the island to determine the extent of damage and the expertise required to begin recovery operations.

Accordingly, the Commander-in-Chief Atlantic (CINCLANT) formed the team under the operations control of Commander, Antilles Defense Command, Roosevelt Roads, Puerto Rico, and deployed it to Dominica to conduct a disaster relief survey. In addition to the medical, helicopter, communications, and civil affairs elements of the DAST, the engineering element members were LCDR Don Keith and UTCM John Magandy of the 20th NCR, Gulfport, Miss., and EQCM Whit Meyers, COMCBLANT Det Gulfport.

Shortly after the DAST arrived in Dominica on Sept 1, LCDR Keith was able to release a message to COMCBLANT from aboard the *HMS Fife*, which was on a port call to the island, that gave the initial assessment of the damaged facilities plus an indication of the expertise and equipment required to start recovery action. LCDR Keith and the two master chiefs were on the island a total of four hours before they evacuated aboard the *HMS Fife* which sailed to Barbados to escape the path of the fast-approaching Hurricane *Frederick*. It was this initial report that kicked off the ensuing mobilization planning by the Atlantic fleet elements of the Naval Construction Force (NCF).

During the next two weeks, there was further disaster appraisal by the DAST members which enabled CBLANT, NMCB-40, CBLANT Det Gulfport and COM 20NCR to complete contingency plans.

Then it happened! On September 14 CINCLANT directed COMCBLANT to deploy a Seabee detail to

(continued next page)

Warehouses of Roseau Port Authority suffered severe structural damage. Photo (facing page) reflects Seabee reconstruction of vital supply storage depot.

Another view of Hurricane David's damage to Dominica's sole hospital. The 10 building complex, urgently needed for treatment of casualties was unroofed.

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Dominica and designated COMCBLANT as the operational coordinator. Accordingly, COMCBLANT designated the Commanding Officer, NMCB-40, who was the resident NMCB deployed to Roosevelt Roads, P.R., as the operational force commander and directed the battalion to deploy a self-sufficient Seabee detail to Dominica. By September 17, 40 members of the detail and eight U.S. Air Force C-130 cargo flights loaded with construction materials, equipment and supplies had arrived in Dominica from Roosevelt Roads, P.R., and Gulfport, Miss.

The next day a total of 25 cargo missions had been flown. Two subsequent Navy Sealift operations from Roosevelt Roads provided additional bulk materials and equipment for Dominica.

A 70-man detail led by LCDR Mike Hadbavny, and Senior Chief Steelworker Mac McClendon set up its base camp at the Roseau Primary School. A second camp manned by 11 Seabees at the Melville Hall Airport served as the logistics resupply point and as base camp for road clearing operations. Ten Seabees from NMCB-1 volunteered from their homeport in Gulfport to strengthen the team. Communications Support Element, MacDill Air Force Base, Fla., and later by a team from the Army's 67th Signal Air Force Base, Fla. and later by a team from the Army's 56th Signal Battalion, Ft. Gordon, Ga., both of which proved vital to the successful execution of the emergency construction.

The emergency projects consisted of:

- Road clearing and repair from Melville Hall to Portsmouth and Melville Hall to Roseau.
- Assisting in the clean-up operation in the city of Roseau.
- Assisting in the establishing of 30 water supply points at various villages.
- Demolition of damaged warehouses at the Port of Roseau and subsequent erection of four 40′ x 100′ pre-engineered buildings for storage of emergency food and medical supplies arriving.
- Replacement of roof trusses and 25,000 square feet of roofing to the ten buildings damaged at the Roseau Hospital Compound.

Underscoring the reconstruction operation was the requirement to expeditiously complete assigned work within 30 days. This condition was crucial to restore essential services and to prevent further dilution of the Atlantic Fleet NCF readiness posture which had already been reduced by the deployment of the 90-man detail from NMCB-40 to Jamaica.

To accomplish the work in this short time, LCDR Hadbavny developed a comprehensive project schedule. In the two major projects, hospital re-roofing and port warehouses, work commenced at 0600 and continued until at least 1700 during the 6½ day work week. Support and assistance was provided by members of the Dominican Defense Force, port authority employees and the local populace. Good-will and appreciation was displayed by the Dominicans as well as the Seabees and the skills taught the Dominicans by the Seabees are believed to have

a lasting effect on the continued recovery efforts of their country.

Working in the area posed some problems. The detail was berthed in an old schoolhouse at Roseau and in a tent camp at Melville Hall. Messing was provided, with C-rations two meals a day, and hot B-rations for the evening meal. With the devastation of the island, all logistical support for subsistence, equipment and project materials had to come from weekly resupply missions from Puerto Rico. Problems arising on site were handled by the representatives of the U.S. Agency for International Development. Diarrhea and dysentery were serious problems due to the contaminated water systems and food. Ten Seabees were medically evacuated during the operation.

On one occasion work was delayed when a bat nest was discovered in the roof of one of the damaged hospital buildings, until it was determined that the bats were not carrying rabies.

The Seabees on Dominica had to fall back on their famed ingenuity to get the job done. On one occasion, when their only crane was inoperative and roof trusses *had* to be hoisted to the third story of a hospital building, SWCS McClendon "made" a crane by welding a 40 ft, 4″ diameter pipe, with guys, to the bucket of a front-end loader. This enabled the 500-lb trusses to the third-story roof.

While visiting the United Nations on October 13, Dominica's Prime Minister requested the United States to continue the Seabee reconstruction effort beyond the original completion date of October 31. On October 25, the detail was extended and assigned additional work:

- Repair/re-roofed approximately 42,000 sf. of roofing on four buildings at the Clifton Dupigny Technical College; one building at the Government Printing Office, and three public works buildings.
- Continue work on selected secondary roads as time would permit.

Phase One of the reconstruction effort was completed ahead of schedule with the following results:

- Approximately 50 miles of roads cleared.
- Nine buildings at Princess Margaret Hospital, Roseau, repaired and re-roofed (32,000 sf.).
- Completed the erection of four 40′ x 100′ pre-engineered buildings.
- Re-opened twelve water points on the island assuring that water was provided to all villages.

Phase II reconstruction efforts were completed on November 22, well ahead of schedule and retrograde operations to extract the men, equipment and tools from Dominica was executed at the end of November.

The superb team effort by all forces involved demonstrated the U.S. ability and willingness to initiate the long, arduous process of social rehabilitation and economic recovery to a devastated country. □

What they said about the Seabees

WITH THE DEPARTURE OF ALL BUT THE FINAL CONTINGENT OF U.S. SEABEES AND MARINES WHO HAVE BEEN ASSISTING WITH RECONSTRUCTION IN WESTERN JAMAICA, I WANT TO REPORT TO YOU THAT THE OPERATION HAS BEEN EXTREMELY SUCCESSFUL. THE SEABEES AND MARINES PERFORMED ADMIRABLY AND ALL JAMAICANS HAVE HAD NOTHING BUT PRAISE BOTH FOR THEIR WORK AS WELL AS THEIR DIPLOMACY. THEIR EFFORTS HAVE CONTRIBUTED TREMENDOUSLY TO STRENGTHENING THE BONDS OF FRIENDSHIP BETWEEN THE PEOPLES OF JAMAICA AND THE UNITED STATES. THEY HAVE ALSO PROVIDED A VIVID DEMONSTRATION OF THE U.S. DESIRE TO COOPERATE WITH JAMAICANS IN THEIR RECOVERY AND DEVELOPMENT. I CANNOT THANK YOU ENOUGH FOR YOUR COOPERATION IN M MAKING THIS ENTIRE OPERATION THE SUCCESS IT WAS. LAWRENCE *(U.S. Ambassador to Jamaica)*

THE SEABEES HAVE ADDED YET ANOTHER SUPERB CHAPTER TO AN UNFAILING RECORD OF "CAN DO" ACHIEVEMENT BY THEIR OUTSTANDING HUMANITARIAN ASSISTANCE TO THE PEOPLE OF JAMAICA. THE HIGH PRAISE OF THE AMERICAN AMBASSADOR FOR THEIR EFFORTS (REF A) CONFIRMS THAT OUR SEABEES ARE NOT ONLY THE WORLD'S FINEST COMBAT ENGINEERS, BUT FIRST-RATE DIPLOMATS AS WELL. PLEASE CONVEY TO THOSE RESPONSIBLE MY PERSONAL "WELL DONE" FOR THEIR ACHIEVEMENT. T. B. HAYWARD. CHIEF OF NAVAL OPERATIONS.

1. IT IS WITH SINCERE PLEASURE THAT I NOTE THE COMMENDATORY MESSAGES CITING THE OUTSTANDING PERFORMANCE BY THE SEABEE/MARINE CORPS TEAM IN THE RECENTLY COMPLETED RECONSTRUCTION EFFORT IN WESTERN JAMAICA. THE SEABEES AND MARINES HAVE HISTORICALLY WORKED TOGETHER AS ONE OF THE MOST EFFECTIVE CONSTRUCTION ORGANIZATIONS WITHIN THE DEPARTMENT OF DEFENSE. THE PROJECTS ACCOMPLISHED ARE JUST ANOTHER PRIME EXAMPLE OF THE FAMED TEAMWORK IN ACTION.
2. I JOIN AMBASSADOR LAWRENCE AND ADMIRAL TRAIN IN EXTENDING CONGRATULATIONS AND APPRECIATION FOR THIS EXCEPTIONAL ACCOMPLISHMENT BEING ASSOCIATED WITH SUCH HIGH CALIBER PERSONNEL ENKINDLES IN ME A SENSE OF GREAT PRIDE. KEEP UP THE "CAN DO" SPIRIT. D. G. ISELIN, REAL ADMIRAL. CIVIL ENGINEER CORPS, U.S. NAVY.

President CEC Rear Selects Two Admirals

RADM (Sel.) HOWARD H. HAYNES, CEC, USN

Rear Admiral (Sel.) Howard H. Haynes entered the Civil Engineer Corps following his 1953 graduation from Texas A & M where he received a Bachelor of Science degree in Mechanical Engineering. He was born in Vanderbilt, Texas, 7 October 1932.

Admiral Haynes' early duty tours included duty as operations officer of NMCB-7.

In 1965 and 1966, Admiral Haynes served as the Construction Program Manager for the Officer-in-Charge of Construction in Vietnam assisting in the mobilization of contractor support for the war effort. He was then transferred to Washington, D.C.

In 1973, Admiral Haynes became Public Works Officer and Officer-in-Charge of Construction at the United States Naval Academy during which tour he completed construction of Rickover Hall, the Naval Academy's engineering studies complex.

Admiral Haynes is a Registered Professional Engineer in the State of Texas. Among other service decorations he has received the Legion of Merit and the Meritorious Service Medal.

He is married to the former Jayne Marie Ward of Coraopolis, Pa. They have five children, Jean Ann Chernikof; Deborah, a sophomore at the University of Maryland; and Melody, Howard and Suzanne.

RADM (Sel.) JOHN PAUL JONES, JR., CEC, USN

Rear Admiral (Sel.) John Paul Jones, Jr., was born August 7, 1932 in Brunswick, Georgia. He was commissioned Ensign upon graduation from the U.S. Naval Academy in June 1954, and subsequently served aboard the *USS Calvert*.

In August 1957 the newly selected rear admiral received a Bachelor of Science degree in Civil Engineering from Rensselaer Polytechnic Institute in Troy, New York, and transferred to the Civil Engineer Corps. His first CEC assignment was with the Public Works Center, Guantanamo Bay, Cuba.

From July 1963 until June 1965 he was operations officer and then executive officer of NMCB Four. Following the battalion tour he served as Officer-in-Charge of the Presidential retreat at Camp David, Md. He then attended the Naval War College in Newport, R.I., graduating in June 1968.

Admiral Jones' decorations include the Legion of Merit with Combat "V", the Bronze Star Medal with Combat "V", the Meritorious Service Medal and the Navy Commendation Medal. He is a Registered Professional Engineer in the State of Virgina.

He is married to the former Wynelle Fender of Brunswick, Georgia, and they have three children: John Paul III, Julie and Karen.

Naval Facilities Engineering Command

SITUATION REPORT

COSO GEOTHERMAL CONTRACT - A contract has been awarded to the California Energy Company, Inc., Santa Rosa, Calif., for development of 75 megawatts of electric power from the geothermal resources at the Naval Weapons Station, China Lake (See Summer/Fall Edition, 1979, The Navy Civil Engineer). The contract calls for the company to evaluate the resource, develop the field and to construct an electric generating plant at no capital cost to the Navy. The company has agreed to sell the power generated at less cost to the Navy than present commercial rates. Overall plans should result in reduction of fossil fuel use and reduction of financial cost plus the major development of an alternate energy resource.

NMCB-4 AND NMCB-62 NAMED BEST - Naval Construction Force commanders have selected two Seabee battalions as Best of Type/Battle "E" winners for overall FY-79 performance. In the Pacific, the Commander of Construction Battalions, Pacific, Rear Admiral Neal W. Clements, CEC, USN, chose NMCB-4 for excellence in performance at Diego Garcia, Port Hueneme, Calif., and Guam. The commanding officer during the period cited was CDR George S. Robinson, CEC, USN.

The Atlantic commander of Seabee battalions, CAPT John C. Fraser, Jr., CEC, USN, selected NMCB-62 as "best of type" for service in Guam, Gulfport, Miss., and Rota, Spain. CDR Julian M. F. Kau, CEC, USN, commanded the unit during the citation period.

MORRELL MEDAL AWARD FOR 1979 - LCDR George W. Yankoupe, CEC, USN, has been selected by the Society of American Military Engineers for his outstanding contribution to military engineering in duties performed as assistant resident officer in charge of construction for the Uniformed Services University of Health Sciences (USUHS) at Bethesda, Md. The award will be presented during the SAME national convention April 24 in Chicago.....The Chief of Civil Engineers, Rear Admiral D. G. Iselin, CEC, USN, has also announced the selection of Master Chief Equipmentman Jarvis O. Wood, USN, as the new Master Chief Petty Officer of the Seabees. As senior enlisted man of the Naval Construction Force, Wood will advise RADM Iselin on Seabee matters. He replaces MCPOF Dwaine Rutherford, USN, in the post which will be effective in early summer.

PUBLIC WORKS TECHNICAL NOTES

Low-flush Toilets

A demonstration at NAVFAC Headquarters introduced a low-flush toilet which merits consideration where multiple units are to be replaced or installed. Low-flush toilets have demonstrated potential savings through reduced water consumption, loading of the base sewage treatment plant or reduced charges for sewage treatment by a municipality. The manufacturer cited one installation of 14 toilets in a highway station where water usage dropped four million gallons per year after installation of the new system.

The toilet is activated by pressing the flush lever which opens a valve in the bottom of the bowl, allowing water and waste to flow by gravity into a secondary compartment below the bowl. There is a complete water wash of the bowl which then refills over the valve to form a seal. At this point, the secondary chamber is pressurized with compressed air and the water and waste are discharged into the normal sewer line. A ½ H.P. compressor with a 12-gallon air tank is sufficient to operate up to seven toilets.

The need for a compressor and tank is the one feature of the system which makes its use for a single toilet uneconomical. Normal water pressure (20-50 psi) is used. Approximately one cubic foot of free air is required for each flush. This is pressurized to 60 psi. The flush cycle is 8 to 12 seconds. The unit discharges to normal sewer piping. The system described operates on a pressure principle; other systems using a vacuum principle are available.

Evaluation of the use of low flush toilets is urged wherever multiple units are to be installed.

Additional information can be obtained from George G. White, Code 1041, NAVFAC HQ Autovon 221-8538.

Coating Materials Are Restricted

Most coating materials presently used throughout the naval shore establishment have already been or are anticipated to be restricted because of health, safety, environmental or supply considerations.

There is, however, an important need for an immediate, though temporary, solution to the problem using available proprietary coating materials which must first receive laboratory and/or field screening before they can be recommended for field use.

A current report on restricted coating materials has been prepared. Exposure data were obtained on primers with alternative pigment materials.

Exposures of coating for steel and wood will continue, and exposures of coatings on masonry will be started with test results to be published in F-181. The final steps will be completion of a maintenance cycle on buildings and preparation of a maintenance coating program for use by NAVFAC field activities.

For further information, contact E. S. Matsui, Code L52, Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, CA 93043; Autovon 360-5430.

Vehicle Maintenance by Night Shift

The Navy Public Works Center, Pensacola, Fla. found it difficult to serve customer requirements with its shrinking vehicle allowance. Vehicles took an average of five days from call-in to shop completion of scheduled preventative maintenance. Customers were understandably reluctant to turn in their vehicles for interim repairs, let alone for preventive maintenance (PM).

A solution is producing interesting results. A night PM crew was established to perform scheduled maintenance, breakdowns and emergent work. A goal of same-night-turn-around was established for all vehicles assigned to the night shift. Three months of operation showed:

- 308 of 324 vehicles were turned around the same night for 95% goal attainment.
- Operational lost time is less than 3%.
- Overall equipment downtime was reduced 60%.
- Mechanical overtime for breakdowns was reduced to zero and minimum overhead was incurred for the night worker leader.
- The day shift is a smooth running, uninterrupted, major repair production line.

The best result is a 97% in-service average and overnight response for critical repairs.

For further information contact John Rhea, Transportation Superintendent, Navy Public Works Center, Pensacola, FL 32508, Autovon 922-4331.

This section of The Navy Civil Engineer is designed for ready exchange of better ways to perform Public Works functions. Readers who desire additional information are urged to contact the contributor directly for specific details. Contributions are urged from field installations and should be submitted directly to the magazine: Editor, The Navy Civil Engineer, Code C20M, Naval School, Civil Engineer Corps Officers, Port Hueneme, CA 93043. Autovon 360-3104; Commercial (805) 982-3104.

SEABEE battalion representatives are introduced to the CM4 system by its designer, Neil Mitchell. The field-oriented computer equipment was tested on Guam and Diego Garcia and is now in use at five overseas locations and three stateside bases.

COMPUTER SYSTEMS

Join the Seabees

By GEORGE R. BERNINGER
Head, Management System
Civil Engineer Support Office

• Port Hueneme, Calif.

Computerized construction? Well, not quite, but computers are improving construction schedules to get more productivity from resources.

Just how can computers help the management process? Although computers have been widely used in the civilian construction industry, doubts existed as to their effectiveness in the rugged Seabee environment. It required the initiative of the then Director of CESO, Cdr George Robinson, to have on-site computer support actually tested by a Seabee battalion. A minicomputer was procured and installed for NMCB-3's use on Guam in September 1976 and was later shifted to NMCB-62 on Diego Garcia. Within 24 hours the Seabees, under the tutelage of LT James Pankovics, of CESO, had the system operational in support of NMCB-3. When later shifted to Diego Garcia the system was made operational in three hours.

The initial question was whether Seabees, who had a minimal amount of computer training, would use the computer when confronted with the press of day-to-day operations. That question was quickly answered as the computer was placed into nearly continual operation. The main problem was trying to schedule everyone who wanted its use. Another question was of equipment reliability, particularly when used in the less-than-ideal physical surroundings of a SEABEE battalion. Again the system passed the test but this time not without some difficulties.

When deployed to Diego Garcia, the nearest repair facility was at Singapore with only one or two weekly flights available. Also an inadequate power source on Diego Garcia caused more equipment failures than had been anticipated. These problems were solved by procuring a spare disk storage device and other parts and by installing a voltage regulator to control the fluctuating power supply.

Results of these first trials surpassed all expectations. As the then Cdr Charles E. Fegley, NMCB-62 commanding officer, put it, "The minicomputer has proven extremely useful . . . It eliminates tremendous amounts of overhead for Alpha Company and provides me with daily information for construction management. I'm looking forward to using the system during homeport to load our networks and other project planning information for the Guam deployment, then being able to have the computer equipment and data with us from the start of the deployment . . ." The results

from the initial tests received the enthusiastic endorsement of NMCB-3's former commanding officer, Capt. James McNeil, as well as Cdr Fegley.

Based on these test results, the Civil Engineering Support Office (CESO), decided to ask for a family of minicomputers to support Seabee worldwide operations. In 1977, the Naval Data Automation Command approved the acquisition of nine minicomputer systems. Structural Programming, Incorporated (SPI), Sudbury, Mass., was the successful bidder.

The acquisition capitalized on the minicomputer's responsiveness, mobility, and reliability to provide an effective, dependable management capability. The selected systems consisted of five items of equipment; Digital Equipment Corporation PDP 11/03 central processing units with CRT and keyboard, 10 megabytes of fixed data storage disks, dual flexible data disks, a line printer and a typewriter. The solid state electronic components were specified because of their reliability, maintainability, and ease of transport. The minicomputer systems are now located at each of the five Naval construction battalion permanent deployment sites—Rota, Spain; Puerto Rico; Diego Garcia; Guam; and Okinawa. Also equipped are the two homeport regiments, the 20th NCR Gulfport, Miss. and the 31st NCR Port Hueneme, Calif.; the Commander, Naval Construction Battalions, U.S. Atlantic Fleet, Norfolk, VA., and the Civil Engineer Support Office (CESO), Port Hueneme, Calif.

The ways in which the computer assists the NMCBs to accomplish their missions are described by the following applications:

• *Construction Management.* An NMCB is a highly mobile, self-supporting unit capable of deploying to practically any geographic location and performing advanced base construction during combat or peacetime. An NMCB has an assigned workload of 40 to 60 projects containing 1500 to 2000 individual work activities. Each activity requires the coordination of construction skills, equipment and material. Until recently these projects were managed with the assistance of an IBM 370/165 computer located at the Facilities Systems Office (FACSO), Port Hueneme, Calif.

Updates to the construction networks were transmitted by mail and a two to six week delay prohibited responsive project planning and management. With the use of the Seabee minicomputer and SPI's construction management program called CM4, access to real time critical path methods now permit more effective use of equipment, materials and personnel, and allows efficient response to daily circumstances and schedule changes. Information relating to activity schedules, network logic, project calendars, resources, and work status can be easily obtained from the system.

• *Project Material.* An extensive planning, supply and control system is required to assure that over 10,000 items of project material for the 2,000 work activities is ordered and available. This complex process was previously manually accomplished with less effectiveness. Now with the Material Liaison Office (MLO) program, material can be tied to specific work activities, losses reduced, and personnel freed to devote more time to planning and management of projects and project material.

• *Equipment Mangement.* Battalions use and maintain over 249 pieces of construction and automotive equipment worth approximately $7.5 million. The minicomputer now allows more effective management of this equipment. Reports can be automatically generated that reflect equipment assignments, "hot equipment" (the 25 pieces of equipment considered most critical to the commander), and equipment that is deadlined. The computer also automatically prints the Equipment Inventory (TAB A) and Equipment Class Codes (ECC) Status reports.

• *Personnel.* The records and various rosters for approximately 21 officers and 563 Seabees were also maintained manually. This problem was especially complex during homeport where men were, at various times, assigned to training,

(continued next page)

Cathode ray tube display (above) and keyboard are part of computer capabilities of overseas Seabee battalions.

Typical disk storage unit (right) of Seabee computer system. Up to 5 million characters can be stored for instant retrieval.

Eager participation by Seabees of NMCB-40 in Puerto Rico is indicated upon receipt of computer hardware.

work details, and travel. Although construction skills of battalion personnel were processed monthly on the IBM 370, this information was not related to the various construction projects and work details. Effective local automation tied into the construction networks now permits more efficient use of personnel and easier determination of required training. Automation also permits more timely information such as the development of rosters, lists of details, and medical inoculations.

• *Text Editing/Administrative.* All NMCB documents (typically numbering over 100) and reports in an NMCB have traditionally been hand-typed. The Seabee minicomputer permits word processing which reduces manual typing, and improves the accuracy and quality of various administrative reports and records.

Before the concept was approved, two basic requirements were imposed—first, that the computer support could be provided without additional overhead to a battalion and second, that the battalion wouldn't be significantly harmed if the computer failed.

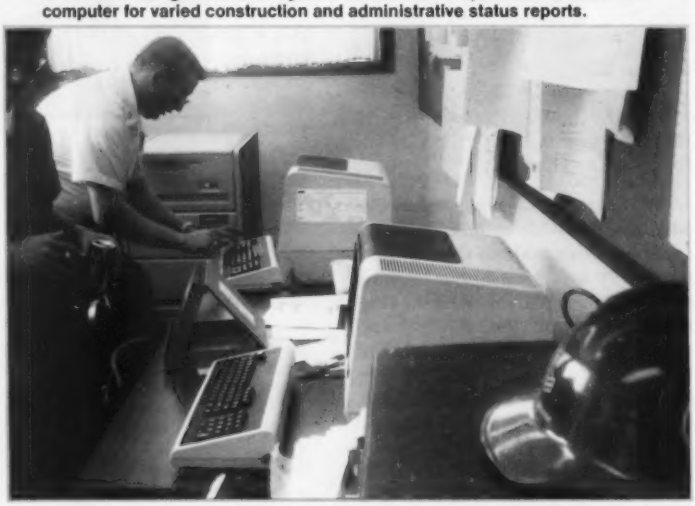
As to the first requirement, CESO selected both hardware and software that allowed functional users easy access to the system. This included training on the system for each battalion while in homeport and also providing software that would lead the uninitiated through intricate computer processes by having him respond to simple tutorial commands.

Referring to the second problem of hardware failures, it was recognized that even the most advanced computers occasionally fail, so that the only reasonable approach was to minimize results in the event of a failure. This was accomplished by requiring detailed redundancy and maintainability features in the hardware itself. For example, an extra five-megabyte disk drive was purchased for each of the overseas locations. These extra disks can readily be switched on-line in the event of a mechanical failure to one of the two prime units. Also, the letter quality printer can substitute for the higher speed line printer. For those components that weren't backed up by overlapping components, a set of repair parts was procured for each site. Additionally, each battalion receives homeport training on the use of the computers' own self-diagnosing, trouble-shooting program which allows the battalion's electronic technicians to easily isolate the hardware item that is malfunctioning, replace it with a good spare, and then exchange the faulty one with the supplier through a modular mailer system of component exchange.

Aside from the direct benefits for Seabee battalions, advantages are also starting to accrue to the Atlantic and Pacific headquarters staffs and the homeport regiments. For example, these commands now receive timely information on construction projects, and status of equipment, materials, and supplies at each of the construction sites. The computers also allow the regiments to plan more efficiently the battalion's homeport training projects as well as to plan long-range construction projects. They also allow for improved management of such areas as regimental supplies, personnel, and administration. In the future, other battalion activities will benefit from their systems, which will include:

• *Supply and Financial.* The sup-

In-house training of the CM4 system will lead to comprehensive use of the computer for varied construction and administrative status reports.



ply and financial operations in a battalion are extensive and entirely manual. For example, each battalion stocks over 10,000 items of repair parts, 2,300 items of tools and consumables, and numerous military items such as weapons and clothing with a total value of $3.3 million. The full NMCB allowance is valued at $10.8 million. And the annual budget exceeds $1 million in addition to more than 20 reimbursable operating targets (OPTARS). Planned automation will improve supply effectiveness by processing stock records, computing stock levels, cutting requisitions, initiating follow-ups and posting to financial records.

- *Homeport Training.* During the six-month homeport period one-third to one-half of the NMCB personnel will transfer from the battalion. This creates a need for extensive training, readiness preparation, and increased administration. The varied training in construction, military and management skills coupled with homeport leave requires complex planning and scheduling. In addition, the detailed planning for the next deployment takes place during homeport time. For these reasons, Seabee operations require the most effective management tools possible. Until recently this complex business was done manually.

The minicomputer offers a tool that can readily be used to experiment with proposed schedule changes that can then be promptly fed back to the Training and Operations Officers.

- *Embarkation.* The 'mounting-out' of a battalion requires the formulation of detailed load plans for ships and aircraft. The minicomputer offers a tool that can readily compute optional load plans based on weight, cube, and load characteristics.

- *Planning and Estimating.* Before projects can be scheduled for actual work accomplishment, various levels of planning and estimating must take place. Macro planning is necessary by the COMCBLANT, COMCBPAC, and the NCR's Operations Staffs to decide what projects to assign to each battalion during their various deployments. These jobs are then planned and estimated in detail to determine what materials and labor are required. Today, this task is performed manually with the help of the Seabee planner and estimator handbook. With the aid of the minicomputer, a planner and estimator could locate the estimate needed for each task and properly compute the total manpower, material, and cost from the tables.

The nine systems have been delivered and installed. Introduction of the computers will have a widespread impact on Seabee operations. A new breed of more sophisticated construction management will emerge. □

COMPUTER TRIAL AND ERROR On Diego Garcia

By LTJG O. L. GREENWOOD, CEC, USN

Big event—the arrival of first field computer equipment on Diego Garcia, in March of 1977. The unit was made operational within three hours.

• Diego Garcia

Use of the minicomputer for construction management in Naval Mobile Construction Battalion Five (NMCB-5) was new to us and to the other battalions in the field. The system on Diego Garcia, B.I.O.T., was one of the first Seabee construction sites to obtain the system and the reactions reported refer to that area.

There were some who were hesitant about the computer and others who thought it was 'great.' For the hesitant ones, all it took was a little convincing and exposure to the computer. In NMCB-5 we were able to accomplish to a great degree the incorporation of the minicomputer for construction management information. Basically, the system takes a significant amount of the work out of initial project planning. It reduces a month's work to a week, perhaps a few days, depending upon the size of the job.

The program that is used is the CM-4 (construction management-4) designed by Neil Mitchell of Mitchell Systems. The CM-4 system is designed to operate on the Wang

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computer. The computer has a keyboard with a cathode-ray tube display used in conjunction with a high speed printer and removable disk drive.

Many have seen the Wang's use in other capacities, but few have viewed it as a construction management tool. Prior knowledge of computer language is not required to utilize the system. With a week of training, one can use the system quite efficiently. Battalions have been training personnel during homeport periods in the application of the computer to construction management. Input is accomplished through a simple question and answer format, enabling one to monitor and make management decisions on a project from start to finish.

In the field, the Seabee construction manager's greatest concern is getting a quality job in the least amount of time and within the budgeted funds. The CPM (critical path method), which is not new to those in the construction field, helps us to achieve our goal.

The project is first broken down into individual construction activities. The various activities are then interrelated in time in a logical project plan. Activity sequences are determined to develop a CPM schedule. Once all of the activities and other required information (i.e., connectors, activity numbers, activity code, estimated duration and resources) have been fed into the computer and processed, a printout can be produced to show the critical path.

Many activities may occur simultaneously while others must be completed before subsequent activities can begin. The graphical representation of the network diagram that is now found on Seabee construction sites is the precedence diagram method (PDM) vice the IJ node or arrow diagram method (ADM). When using the PDM, the node represents the activity.

There is always the need to revise and correct information on a construction project plan in practical applications. The CM-4 system allows the project manager to conveniently edit any item of information on the project at any time. Editing should not be confused with updating. Editing is correcting information or making changes to information previously fed into the computer, whereas updating is reporting progress on the project. Updating should be done weekly, bi-weekly or monthly depending upon the rapidity of job progression. Correct management decisions can only be made if the project network is updated regularly to provide a true picture, on the computer, of what is actually taking place in the field. Weekly updates have proven to be particularly useful in managing several of our Seabee construction projects.

The author exchanges storage disks of pioneer computer unit tested on Diego Garcia. The system has been replaced with contemporary models.

CM-4 has the capability of producing numerous reports. The reports most useful for managing construction effort on Diego Garcia are: predicted status report, resource usage by activity, milestone report, and bar chart schedules. Additionally, the system easily prepares: network logic reports, field reports of progress, a library of available resources, and a target report (which compares the original network to the updated network). Each of these reports can also be tailored to the user's requirements.

Not all of the available reports are useful in managing Seabee construction projects; however, most of the available programs can be tailored for effective utilization. Some might debate the difference between Seabee construction and other construction, but there are some unique situations which Seabees have to deal with, such as the many administrative and military duties that reduce construction time. It is not necessary that personnel in the field know the CM-4 system, but it is necessary that they submit accurate field information. Otherwise, management will be looking at erroneous reports. Those familiar with computers know the adage "your output is only as good as your input."

Within a very short time and with a little more involvement, the old timers in Seabee construction will be convinced that the mini-computer with CM-4 can be used to fully manage a construction project.

One thing to remember is to keep the scope of activities within a reasonable number so that the job is manageable. What the system does is no different than what most of us have been trained to do by hand, but it does it faster and with greater accuracy. □

AN OPINION OF COMPUTER USAGE BY

Seabee Battalions

By EAC TIMOTHY F. BUCKLEY
P.E., Calif.

Author Buckley (right) believes that the new computer systems haven't reached their full potential for battalion use.

• Port Hueneme, Calif.

The minicomputer and its associated software are now integrated into the Naval Construction Force to assist in the management of construction projects. The little machine should do a big job. In addition to construction management, there are other programs to assist in the management of battalion personnel, construction supplies, and automotive and construction equipment.

In the "build, fight" realm of the Naval Construction Force, effective management of the construction effort has a high priority. Just what is construction management? Commercial construction interests view it as management of time and cost in relation to a completed project.

The Naval Construction Force views construction management slightly different. Their definition is the timely use of available resources to construct a quality product in a desired time. Is the Naval Construction Battalion configured for construction? The answer is no.

Any construction company doing the volume of construction performed by Seabees could not survive if it was organized like Seabee battalions.

Why then does the Naval Construction Force attempt to do construction with a tactical organization? For effective construction management, there needs to be a distinct division between the tactically organized battalion and the battalion structured for construction assignments.

With the flexibility of the manpower programs of the minicomputer the battalion can feasibly be organized into two separate and distinct configurations. The tactical configuration places personnel in the battalion organization according to rank, rate, and tactical function, thus producing an organization capable of conducting military operations including limited assault, but primarily oriented towards perimeter defense. Initial organization requires identification of the headquarters company and the battalion staff; then company commanders and their staffs are selected.

After this organization and placement is complete, the remaining personnel in the tactical configuration can be assigned. Qualified and capable personnel are placed in required leadership positions, i.e., platoon commanders, platoon guides, squad leaders, etc. The remainder of the personnel is distributed in the tactical organization according to their ability to meet the functional requirements of the tactical position.

In the tactical configuration there may be very few equipment operators in Alfa Company or very few builders in Charlie Company. Remember, this is the tactical configuration and is not designed for construction activities. In this configuration the company staff will administer and coordinate all the required training programs and other functions for personnel through the tactical chain of command. The squad leader must be strong in military and leadership traits to ensure successful company administration.

Now the construction configuration must be identified. Initially, we must identify those persons necessary to provide construction support, i.e., CM shops, camp maintenance, planning/estimating, construction inspectors, project staffs (project manager, superintendent, leading petty officer, and expediter), and other indirect labor functions requiring permanently assigned personnel.

What then remains is a limited labor pool that can be devoted to direct labor. By now the question arises; how will all these people and jobs be identified and tracked? With the computer software this can be accomplished; first by using the 'people program' and second by use of the watch, quarter, and station bill (with minor variations to permit its use by the Seabees).

The limited direct labor pool is broken down into trades *not* ratings. For example, the person is not identified as a construction electrician;

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the rating encompasses lineman, interior wiring electrician, telephone installer, and fire alarm technician. Instead, the manpower assignment will be made to match the particular task required (i.e., install a pole line) with an individual with that particular training (i.e., a lineman). The Personnel Readiness Capability Program (PRCP) can be used to monitor the strength the battalion has in all trades and with timely updates it will be crucial in the effective identification and distribution of the labor pool.

No construction project can be completed on or near the finish time without a flexible and manageable schedule. For years Seabees have been breaking down construction tasks down to minute detail; creating considerable construction schedule management problems. An example would be the placing of a concrete slab. From the plans and specifications there is a need for a vapor barrier and reinforcement in the form of welded wire fabric. There is always such a requirement for fine grading and form work. In the curent mode of operation Seabee planners break down placing the slab into: fine grade, vapor barrier, reinforcement, placing and finishing concrete, when one activity, *place concrete slab,* would suffice. The single activity, place concrete slab, makes the schedule less bulky and easier to manage.

Another area causing construction schedule headache is the management of resources. Resources are the men, machines, and materials required for construction. Again Seabee planners tend to reduce resources down to the smallest unit. That is to say they don't use the concrete crew as a complete resource. It is broken down into crew leader and helpers resulting in two resources to manage. The same is true when equipment is involved, the equipment to be operated is one resource and the operator is another; again, two resources to manage. Careful resource allocation, leveling, or a combination of both is necessary to maintain a manageable schedule. Selection of the proper labor resource must be done by the *trade* and not the rating as mentioned before. Equipment resources must be sequenced through the schedule to ensure equipment availability for other assigned construction projects. The goal of resource allocation and leveling is to more readily manage the labor force and equipment requirements.

Construction Management is a "family affair." All phases, sitework (equipment operators), structural (builders and steelworkers), and utilities, (utilitiesmen and construction electricians), must be involved in the preplanning and the scheduling. First looking at the major elements, i.e., sitework and its relation to utilities, etc., is the *macro* level of planning and scheduling. Next the major elements such as sitework are broken down into smaller activities, i.e., clear site, rough grade, etc., and is the *micro* level of planning and scheduling. At this level, dependencies and sequencing take place for a smooth flowing schedule.

When all this is accomplished separating the battalion into tactical and construction configurations, keeping the activities and resources manageable, and using people with the expertise in each phase of construction the Naval Construction Force is ready to effectively use the minicomputer to assist them in construction management. □

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Seabee Center Update

BY LEONARD M. SEIGEL
CBC Command Management Division, NAVFACHQ

• Alexandria, Va.

The Naval Construction Battalion Center at Davisville, R.I., now serves as the host activity for four major Naval Reserve Construction Force units: the Reserve Naval Construction Regiment, (7th RNCR) which has operational control of two Reserve Naval Mobile Construction Battalions—RNMCB-12 and RNMCB-27; 21st RNCR, which has operational control of RNMCB-13; RNMCB-12; and Reserve Naval Construction Battalion Center (RNCBC), Davisville, the reinforcing unit.

Collectively, the center is monthly supporting nearly a thousand Seabee Reservists. The center is ideally suited to provide training in all phases of battalion regimental operations, including air/sea embarkation exercises.

During June 1980, CBC Davisville will host a composite Battalion for active duty training, with concurrent mobilization training being provided to RCBC Davisville and the 21st RNCR. The composite battalion will be comprised of reserve personnel from all areas of the continental United States.

CBC Gulfport (Miss.) is now operating its new construction equipment department (CED) for the repair of fleet civil engineer support equipment (CESE) as well as processing CESE and other equipment for storage as prepositioned war-material stock (PWRMS).

The Gulfport CED, which was dedicated on 3 October 1979, is unique to the NAVFAC family in that it was specifically designed for heavy equipment repair and processing. The latest environmental safeguards have been incorporated into the design to insure efficiency and safety. The operation of the $4.2 million facility will enable the NCF to meet its mobilization mission in direct support of fleet world-wide operations.

A new master plan was recently completed for CBC Port Hueneme (Calif.). The plan incorporates several highly innovative planning concepts which will enable the center to carry out its primary mission as well as supporting functions performed by more than 50 tenant commands.

Future plans include new and expanded facilities for the Naval Construction Training Center (NCTC), including a streamlined heavy equipment training and operations area; a new outpatient clinic to replace the present hospital; new administrative facilities; modernized pier and loading facilities; a new, consolidated open mess facility; and "green belts" to enhance the visual perspective of the base. □

Norfolk Center Offers New Tech Courses

The NAVFAC Technical Training Center (NTTC) was established 8 December 1964 by the Naval Facilities Engineering Command (NAVFAC) and placed under the command and management control of the Commanding Officer, Navy Public Works Center, Norfolk, Virginia.

Its role is to provide Navy wide technical training in facilities maintenance and utilities operations in four ways:

home study correspondence courses; contracted and arranged courses; career guides, training plans and outlines; or through special projects.

The regular curriculum of 31 correspondence courses and 15 recurring contract courses have been supplemented this year by the addition of four resident courses:

NTTC #600 Electronic/Electrical Controls & Distribution Systems
NTTC #601 Intrusion Alarm Systems
NTTC #602 Fire Alarm Systems
NTTC #603 Electronics for Electricians

A training course catalog with more details is available upon request. Contact:

NAVFAC Technical Training Center, Navy Public Works Center, Norfolk, VA 23511, or call:
Autovon 690-7260 or 690-2586

Turbidity Control

By LTJG D. J. O'LOUGHLIN, CEC, USNR

• Puerto Rico

A bulldozer churning through the surf zone might make an environmentalist apoplectic, but a simple floating curtain surrounding the construction site, will assuage his sensibilities and may even invite a smile on a otherwise stoic face.

An environmentalist knows that bulldozing or other construction operations in costal waters will generate a blanket of suspended sediment that could smother the life from coral reefs and bottom dwelling organisms, but he also knows that a curtain will contain sediment and nearly eliminate damage to the environment.

Sediment containment is a necessary prerequisite for most marine construction to be compatible with the environment. In a procedure called "turbidity control" floating impermeable "turbidity curtains" are used to contain construction generated sediment and protect the marine environment.

For the Seabees and CEC Officers at the Public Works Department, Naval Station Roosevelt Roads, turbidity control was a new and educational aspect of environmental protection. But, however new and different, turbidity and turbidity control became household words when they were required to construct two boat ramps on the Impact Range of the Atlantic Fleet Weapons Training Facility (AFWTF).

The AFWTF Impact Range, which provides targets for aerial and naval gunfire ordnance delivery, is located on Vieques Island, Puerto Rico. Consequently, the Commonwealth of Puerto Rico Water Quality Regulations apply to the water surrounding the range and the ramp construction sites. These regulations prohibit the degradation of the natural turbidity of the ambient waters beyond prescribed limits. At the boat ramp construction sites, the Commonwealth regulations require that a white 30 cm. diameter plate or Secci disk, be visible at a depth of one meter.

Once construction began, it became obvious that local turbidity limits were being exceeded. Upon recognizing the need for tubidity control, construction was stopped and a means to contain the suspended sediments was sought.

An extensive effort to locate a turbidity control curtain in Puerto Rico failed. A curtain might have been available for rent, lease or purchase but time limitations mandated that a substitute be created from available resources. The Naval Station Public Works Seabees tackled the design, construction and development of an effective turbidity curtain.

A construction plan evolved after a discussion of the desired curtain characteristics. A curtain that floated on the surface and reached to the bottom was desired. A permeable curtain material that allowed water transport while prohibiting the migration of suspended sediment fines was sought. Ballast material for the curtain was considered necessary to minimize skirt movement from wind and wave action. Finally, the curtain had to be easily assembled on a remote island beach, easily deployed by three or four men and sturdy enough to withstand the marine elements and rough handling.

After considering the desired boom characteristics, it was decided to fabricate a turbidity curtain by adding a ten-foot canvas skirt to sections of oil containment boom on hand in the station's oil spill equipment. Ten-ounce canvas was cut into ten-foot by fifty-foot sections, hemmed and grommeted along the top and sides, and provided with pockets along the bottom edge to hold ballast material. The canvas and oil boom were fabricated as pictured in the schematic drawing.

The curtain was deployed in sections. After assembling the 50-foot sections, the skirt was rolled around the pipe ballast and each section was floated into position around the construction site. When the sections were in place, the skirt was unrolled and laced together. Lightweight anchors and grappling hooks were used to anchor the curtain.

Experience with the boom indicated that lacing the skirt sections together did not provide an ade-

quate enclosure. The lacing allowed the skirt to bunch together thus creating sizeable openings in the curtain structure. An alternate method of joining the skirt sections by clamping the skirt edges was devised and used in lieu of lacing. This technique proved successful.

The turbidity curtain was successfully used at two construction sites. The curtain served well under the prevailing conditions. About 75-percent of the construction generated sediment was contained by the curtain. As a temporary device, the ten-ounce canvas proved sufficient. However, after two weeks of exposure to sea and sun, the fabric was severely deteriorated. A stronger curtain fabric would be required for more permanent applications.

The "custom built" curtain served for the intended purpose—to provide an immediate short term workable solution. However, after completing the boat ramp installation, a marine construction supply company was contacted to obtain information on commercially available curtains suitable for sustained use.

Turbidity control curtains have developed along the lines of the more familiar oil spill containment booms. Different models are available for use under various environmental conditions. Wind and current action and the nature of the sediment itself are the primary factors that are considered when designing or choosing a curtain for a particular application.

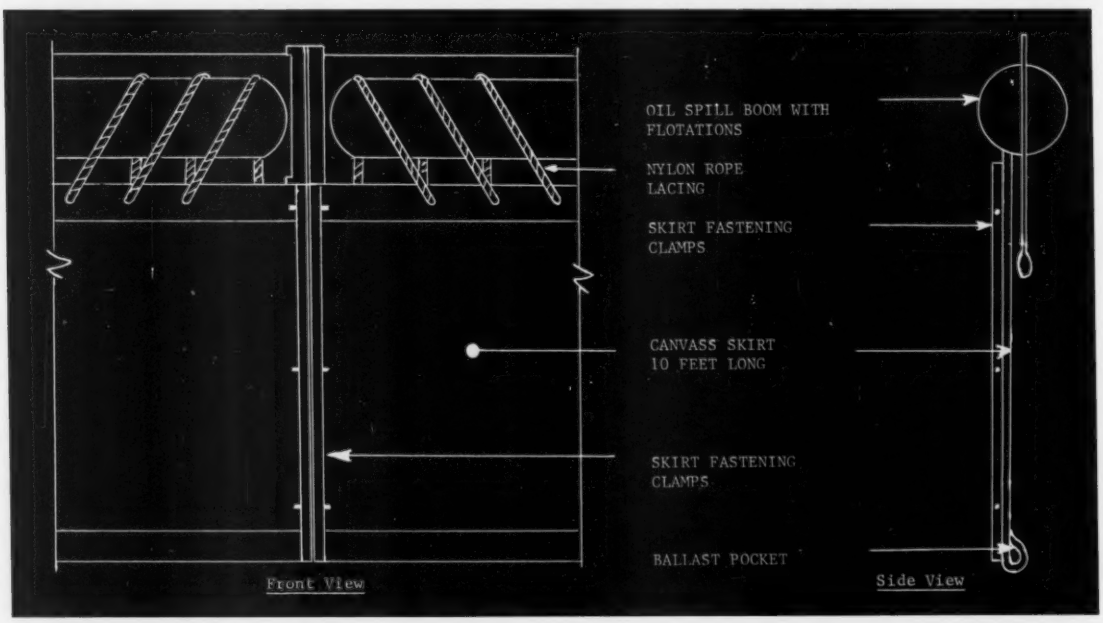
Basically, commercially available curtains consist of an impervious skirt, a floating collar and fastening devices for joining skirt sections. Skirt fabric weight and features are a function of the intended application. Curtin skirts, floatation collars and connect/disconnect systems designed for "slowwater," low wave applications are augmented with heavier fabrics and additional strengthening members for "fastwater," high wave environments. Some typical curtain designs are pictured.

Review of available literature indicates that most turbidity curtains are avialable for use in different water depth applications. Some curtains are available with skirt length of 30-feet. In deep water applications the curtains are not always extended to the bottom, since density currents and water temperature differences often serve to contain sediments at depths where surface effects are dampened. In such cases only surface containment is required.

For large projects and extensive applications, turbidity curtains are designed for specific applications. Major construction in the marine environment now requires that considerations for turbidity control be thoughtfully developed. The cost of turbidity control demands that adequate consideration be given to these procedures in order to minimize expense.

Cost is of course an important factor. Prices in manufacturers' literature range from $6.40 per foot for three foot skirt/still water booms to $36.50 per foot for 30 foot skirts/fast water designs. At prices approaching $40 per foot, turbidity control for even a small project can become a major expense. Had a commercial boom been obtained for for the boat ramp installation, a cost $3800 would have been incurred. Material cost for the boom that was fabricated was approximately $1500.

The boat ramp installation proved to be an interesting and educational undertaking. It illustrated to those involved, that effective environmental protection can often be developed by utilizing available resources without resorting to costly alternatives. It also provided insight into an aspect of environmental protection not previously experienced.□



Concrete Batch Plant

To Bury or Repair?

By LT D. G. ROACH,
CEC, USN NMCB-5

· Diego Garcia

What do you do when your $200,000 concrete batch plant is deteriorated and worn to the point that breakdown time outnumbers operable time?

Normally with a mobile piece of equipment there are two options: either bury it and buy a new one, or overhaul and rebuild it.

To complicate things, however, what if you're on a small island in the Indian Ocean on the opposite side of the globe from Denver, Colorado, the plant's manufacturing and assembly site?

The obvious choice starts to look like burying it and buying a new one!

The Seabees of U.S. Naval Mobile Construction Battalion Five (NMCB-5) were recently faced with these choices. When the 560-man battalion deployed to Diego Garcia in March of 1979, they assumed responsibility for 518 pieces of equipment which included two concrete batch plants. The larger was capable of producing approximately 100 cubic yards per hour, but salt air, coral dust, and hard use had rendered the secondary plant unreliable.

Several factors had to be considered in making an intelligent choice. The primary one, of course, were the construction projects requiring concrete. During their scheduled 8½ month deployment, the battalion anticipated using about 15,000 cubic yards of concrete. Projects included a runway extension, trestle and pier, and foundations and slabs for various structures. One concrete plant could normally support these requirements, but if it was inoperative for even a short period, several high priority projects would be delayed.

And, being isolated in the Indian Ocean added a new dimension to the problem. Resupply ships have taken 30 days to travel from the U.S. West Coast and they are scheduled on a quarterly basis. Urgently required items can be flown in, but the cost for anything of size is prohibitive.

When considering the option to overhaul the plant, it should be remembered that Seabees are not trained for, nor expected to perform major, complete overhauls. This is normally done at the Construction Equipment Department (CED) at CBC Port Hueneme, California. (See page 15 for new CED facilities.) To get the junior plant to California would require that it be completely dismantled for shipment and repair with perhaps a year lost before it was returned, reassembled and operating.

Looking at these risks, the Seabees of NMCB-5 decided that they would attempt to do the overhaul on the island site. In May 1979 a construction mechanic (CM), a construction electrician (CE), and a steelworker (SW), all with considerable experience with the plant, undertook the job. The three men faced a deadline of six months (November 1) to complete their unproven assignment.

First they dismantled the plant for a complete inspection of the aggregate and cement hoppers, gates, conveyor rollers, motors, compressor, wiring, and frame. The highly corrosive atmosphere on the coral atoll had caused many sections to deteriorate so badly that they broke under slight pressure.

The metal was sandblasted, bad sections identified, cut out, replaced and prime coated before the corro-

DURING overhaul, aggregate hoppers are back on the repaired frame.

sive air could renew its assault. Priority construction projects required the sandblast equipment during daylight hours so the three renovators worked the sandblast equipment at night and returned it for the daylight construction jobs.

While the steelworker repaired and rebuilt the metal, the construction mechanic replaced bearings, gears, shaft, rams and gates. The construction electrician, in turn, worked the motors, switches, relays and wiring. It was, however, a coordinated effort, each leading the others in the area of his expertise.

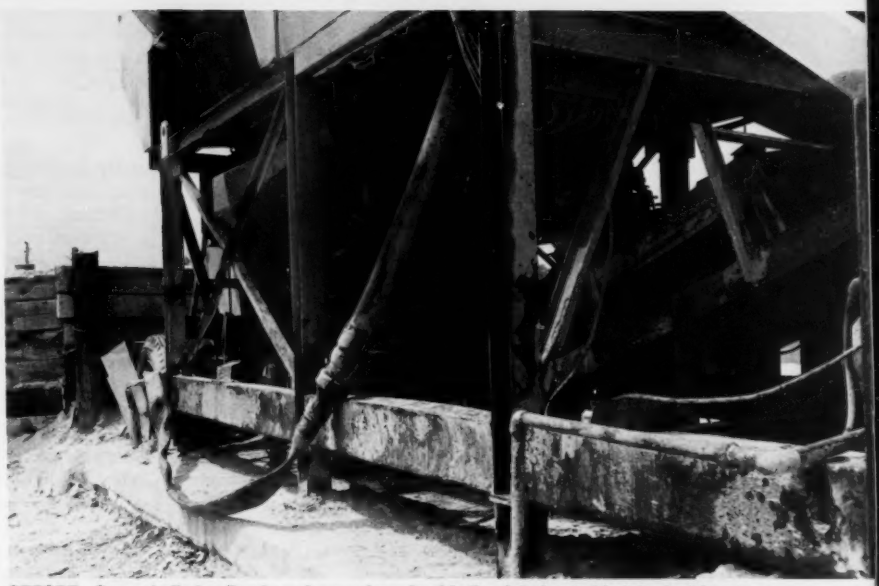
The actual reconstruction of the plant started in July. It was a long and tedious process, electrical power and water source tied in, pumps, motors and compressor hooked up, pulleys and belts adjusted, switches and relays properly connected with particular attention paid to alignment of moving parts. A Singapore contractor arrived in September to calibrate the cement and aggregate scales.

The do-it-yourself job was completed by October 15, with the first test a week later when eight cubic yards of 3,000 psi mix and eight cubic yards of 4,000 psi mix were batched out.

The three rebuilders were on hand to await the verdict of their handiwork. As the transit mixers accepted their loads, the plant ran with near perfection. Test cylinders taken on the concrete proved that the product was also of high quality.

The cost of the overhaul effort cannot be exactly calculated. The three Seabees expended 2,994 manhours of labor and used $2,411 worth of parts. Using the standard Navy pay rate of $10.00 per hour, and adding another $5,000 for material (steel plate, welding rod, nuts, bolts, etc.), the total cost is roughly $37,000. Most important, the overhaul was completed within five months. Comparing this with dismantling, shipping and reconstruction costs plus a minimum of a year to complete the cycle, the savings are substantial.

The Seabees undertook a job they were not trained for nor expected to perform. They considered the options, made the choice, and proved themselves. □



BEFORE—Cement silo loading hose hangs down beside the deteriorated batch plant frame.

AFTER—Crane loads the aggregate hoppers while concrete is batched into a transit mixer.

Abstracts of Theses

By LT LOREN W. SMITH, CEC, USN
E.I.T., Guam

The CEC officer, in his or her role as an engineer-manager, is faced with a variety of both technical and "people" problems. We deal with both types of situations but seldom have time to study in detail the management or engineering principles involved. Through the postgraduate program the CEC officer is given the opportunity to study a particular problem in depth and preserve the results of his efforts in the form of a thesis.

Two abstracts of graduate theses are presented which represent the study of two important but diverse topics: leadership in organizations and energy conservation in building cooling and heating systems.

LCDR Jim Watson has studied leadership styles as they relate to organizational climate and employee job satisfaction. Using survey methods and statistical analysis he has examined the influence of the leader on the organization and its employees.

LT Bill Morrison's study of heating, ventilation and air-conditioning systems is particularly useful in that he examines methods to make our existing systems more energy efficient through control system modifications.

The Moreell Library at the Naval School, Civil Engineer Corps Officers, maintains a loan copy of these papers. For theses with an "AD" number, a personal copy may be purchased from the Defense Technical Information Center, Cameron Station, VA 23314 ($3.00 hardbound or 95¢ microfiche).

THE INTERACTION BETWEEN LEADERSHIP, CLIMATE AND SATISFACTION IN A PROFESSIONAL ORGANIZATION

Key Words: Leadership, Job Satisfaction, Organizational Climate.

Abstract: This thesis begins with a review of literature dealing with supervisory behavior, organizational climate and individual job satisfaction. Previous work on leadership styles is discussed. The hypothesis tested in this study examined the differences between "task" and "people" oriented leadership styles and their effects on the climate of the organization and employee satisfaction.

An organizational survey was conducted by the author within an Engineering Field Division (similar to the Human Resources Management Surveys conducted elsewhere in the Navy). Using statistical correlation techniques, it was found that supervisory styles do have an effect on the climate of the organization as perceived by the individuals in the organization. It was also indicated that the organizational climate has an influence on employee satisfaction.

Statistical findings supported the hypothesis that high supervisor concern for both "task" and "relationship" would correspond to high employee satisfaction and highly favorable perceptions of the organizational climate, and low supervisor concern for both "task" and "relationships" would correspond with low employee satisfaction and unfavorable perceptions of the organizational climate. However, the hypothesis that high concern for "task" and low concern for "relationship" would correspond with low satisfaction and that high "relationship" and low "task" concern would correspond to higher employee satisfaction were not supported.

An extensive bibliography of leadership and organizational theory references is included.

Reference: *Watson, James Preston, LCDR, CEC, USN* "The Interaction Between Leadership, Climate and Satisfaction in A Professional Organization," Naval Postgraduate School, December 1974.

Thesis: Master of Science in Management.

AD # A004292

CONTROL STRATEGIES TO CONSERVE ENERGY IN ALL-AIR HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

Key Words: Energy Conservation, HVAC, Heating Systems, Cooling Systems, Ventilation Systems.

Abstract: Commercial and residential buildings consume approximately 37 percent of the energy used in the United States. Heating, ventilation and air conditioning (HVAC) for these buildings utilize approximately 50-60% of this energy. This thesis explores methods of modifying the HVAC control systems in existing buildings to reduce energy consumption while maintaining comfort levels.

Six typical HVAC systems are examined in this report, including both constant and variable volume installations. Energy saving modifications are proposed, starting with low cost control adjustments and continuing through minor and major system modifications. There is a discussion of the equipment required to accomplish the monitoring and control of HVAC systems and a comparison of the advantages and disadvantages of centrally based microprocessor controls.

The study concludes that the improvement of existing HVAC control systems can reduce energy consumption with little or no loss of comfort to the building occupants.

The report contains an extensive bibliography on the subject of HVAC control systems and energy conservation.

Reference: *Morrison, William James, LT, CEC, USN* "Control Strategies to Conserve Energy in All Air Heating, Ventilation and Air Conditioning Systems," University of Colorado, May 1979.

Thesis: Master of Science, Department of Civil and Environmental Engineering. □

Qualified engineering students may earn over $700 a month prior to graduation

□ Students must be a U.S. citizen, between the ages of 19 and 27½ years, and within 12 months of graduation and enrollment at an institution accredited by the Engineers Council for Professional Development . . . .

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What to do about hazardous wastes?

Engineering College Students

See inside covers for details concerning an exceptional opportunity leading to a commission in the U.S. Navy!

The Navy's Civil Engineer Corps through the Naval Facilities Engineering Command is engaged in a full scale battle against environment damaging industrial residues (Counter clockwise) Two photos demonstrating careless disposal of wastes; and two photos indicating proper cleanup of spills and a neutralization and disposal plant.

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